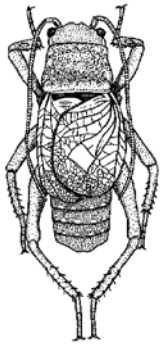

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NEW LEPIDOPTEROLOGICAL FINDS (LEPIDOPTERA: GELECHIIDAE, TORTRICIDAE, GEOMETRIDAE) IN SOUTH OF RUSSIAN FAR EAST

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The investigation of the Lepidoptera in the rare ecosystems allows showed up the species firstly recorded for the Russian Far East. Founded micromoths: peach twig borer *Ananarsia lineatella* (Zeller), seedworm *Grapholita dimorpha* Komai, and geometer *Apocheima cinerarius* (Erschov) are serious pests of gardening. New synonymy is proposed: *Apocheima* Hübner, 1825 = *Yala* Chu, 1979, **syn. n.;** *Apocheima cinerarius pyri* Yang, 1978 = *Yala pyricola* Chu, 1979, **syn. n.**

KEY WORDS: Rare vegetations, Lepidoptera, Gelechiidae, Tortricidae, Geometridae, pests, first record, Russian Far East.

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Исследование чешуекрылых в редких экосистемах позволило выявить виды, впервые регистрируемые на территории Дальнего Востока России. Обнаружены микрочешуекрылые: фруктовая полосатая моль *Ananarsia lineatella* (Zeller), плодожорка *Grapholita dimorpha* Komai и пяденица *Apocheima cinerarius* (Erschov), которые являются серьезными вредителями садоводства. Предложена новая синонимия: *Apocheima* Hübner, 1825 = *Yala* Chu, 1979, **syn. n.;** *Apocheima cinerarius pyri* Yang, 1978 = *Yala pyricola* Chu, 1979, **syn. n.**

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INTRODUCTION

The south of Russian Far East is well known by high level of biodiversity, which is anomalous for it's latitudes, and by high heterogeneity of natural environment with considerable portion of rare types of ecosystems, a quick of which a combination of rare ecotopes and rare plant communities is constitutes (Krestov, Verkholat, 2003). The rare ecosystems are widely represented especially in west and south-west boundary districts of the Russian Far East and still insufficient studied. The investigations of them, conducting during the last years, revealed two reasons of the topicality of intensive control of their biodiversity. First, in many cases rare ecosystems are small, more or less complete, isolated fragments of their more wide areas on the territory of adjacent countries, or contain species from other natural zones. Usually the ecosystems differ by peculiarity of arthropod fauna and inhabited by many rare and local species. The biodiversity of such ecosystems is highly sensitive to climatic and anthropogenic environmental transformations. Second reason is that the rare ecosystems could be potential reserves of economically important marginal populations of plants and animals, and could serve as sources of pest invasions in coterminous agrocenoses. On the other hand, the rare ecosystems can be considered like ecological "bridges" for coming of some serious pests of agriculture and forestry on the territory of south Far East. This aspect has grounded significance of permanent control of the biodiversity of these ecosystems, especially in view of global changing of climate.

The initial analysis of the fauna of the rare ecosystems allowed to reveal not only firstly recorded species for Russian Far East, but also new species for science (Beljaev, 2003, 2004; Ponomarenko, Omelko, 2003). In the present paper three new species for the Russian Fart East are reviewed. All of them treated as serious agricultural pests in neighboring countries. It is impossible to establish whether the species aboriginal or recently penetrated to the Far East from China because of poor insect investigations in western parts of Primorskii krai in XX century. However reliable recent spread of large hawk-moths in South of Primorskii krai (Beljaev, 2003) allows to suppose an invasion at least some of the species treated below.

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Abbreviations: FSVPS PA - Federal Service for Veterinary and Phytosanitary Supervision of the Russian Federation, Primorsk Agency, Vladivostok; IBSS - Institute of Biology and Soil Science, Vladivostok; SZMN - Siberian Zoological Muzeum, Novosibirsk; ZFMK - Zoologisches Forschungsinstitut und Museum Alexander Koenig, Bonn.

***Ananarsia lineatella* (Zeller, 1839)**

Figs 1-4

Anarsia lineatella Zeller, 1839, Isis: 190 (type locality: Europe).

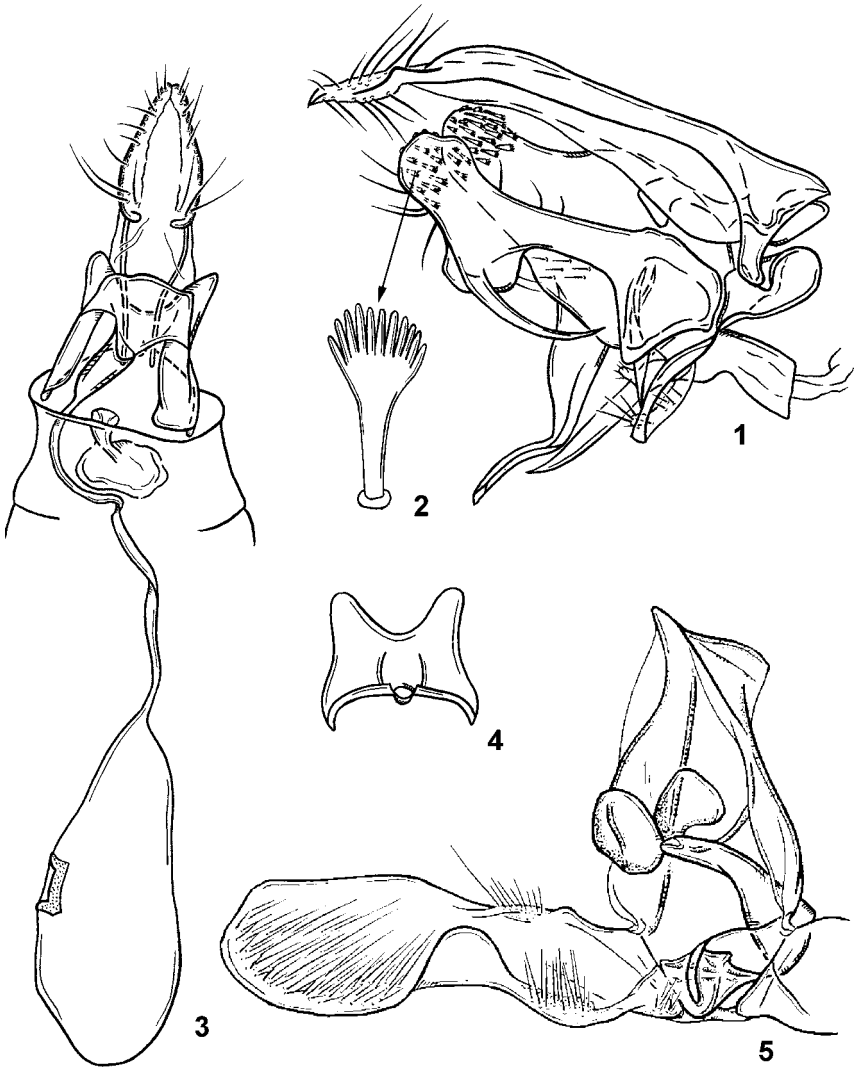
DIAGNOSIS. The wingspan 14-16 mm; the forewing grey with longitudinal dark-grey strokes; right cucullus with the strong sclerotized processes, arising from its outer

surface, and uncus evenly narrowed distally in the male genitalia (Figs 1, 2); ovipositor short, VIII sternite sclerotized beyond the ostium and signum emarginated on the anterior and posterior margins in the female genitalia (Figs 3, 4) (Ponomarenko, 1989; 1999).

MATERIAL. Primorskii krai: 1 ♂, Oktyabrskii distr., 16 km W Pokrovka, vicinity of Chernyatino and Sinel'nikovo, mouth of Orlikha river, 31.V 2002 (leg M. Ponomarenko); 1 ♀, Ussuriiskii distr., 5 km E Nikolo-L'vovsk, 15.VIII 2002 (leg M. Ponomarenko) (IBSS)

DISTRIBUTION. Europe, Russia (Primorskii krai - first record; European part), Caucasus, Transcaucasus, Central Asia, China, Africa (Algeria, Egypt, Libya, Morocco, Tunisia), Asia Minor, Afghanistan, Nearest East, Iran, Iraq, Pakistan, India (Kashmir), N America (Canada and USA), Australia.

BIOLOGY. The number of peach twig borer generations per year varies from one to four, depending on climatic conditions (Price & Summers, 1961; Wolff, 1965; Berlinger, 1969; Baulina, 1970; Bagdavadze, 1971; Gokhelashvili & Khabaradze, 1974; Vasil'ev, 1974; Oloumi-Sadeghi & Esmaili, 1983; Brunner & Rice, 1984). Usually the larvae of 1-st and 2-nd instars overwinter in hibernaculum, which is excavated in the bark, in the branching of two- four-year-old shoots, in the buds, also they pass the winter in the galls of the plum tick *Eriophyes phloecoptes*. In the spring the larvae resume their development when the temperature rises up 8.5-10^{o}C. They bore the buds, burrow the terminal shoots, and sometimes damage the leaves. Every caterpillar damages up 4-5 shoots before its pupation. The larva of the last instar reaches the 10-12 mm in the length; and is reddish-brown with dark-brown, almost black head, prothoracic notum and anal plate; the thoracic legs are black. The area between body segments is lighter in colour, due to striped appearance of the larvae, the *Ananarsia lineatella* is called also as fruit striped moth, mainly in Russian publications. The larvae of the first generation pupate on the trunk or branches in the bark cracks and in the shoot branching in the light-grey cocoons. The pupa is about 6 mm in length, dark-brown, and with cremaster as hooked hairs. The adults of the first generation appear from second ten-days of May (in some countries from end of April) to second ten-days of June. They oviposit at the base of buds, on the under surface of leaves, in the leaf angles, on the shoots and in the growing fruits during 2 weeks. The emergence of second generation larvae depends on the temperature and humidity. Under the conditions, that temperature is about 18-20 C and 70 % humidity, the larvae appear through 6-7 days, provided that temperature is about 23 C and 60 % humidity the larvae appear through 4-5 days. The caterpillars of second generation, besides the buds, terminal shoots and base of leaves, damage the growing fruits. Their pupation is not only in the bark cracks, but before the inlet into the fruits. The larvae of the second generation do not make cocoon before the pupation. The flight of the second generation adults prolonged from the end of third ten-days of June to the beginning of August. The moths oviposit on the bark of trunk and branches, and on the fruits. The development of the third generation depends from the region of the moth's existing and place of oviposition. The emerged larvae from eggs on the trunk and branches usually excavate the hollows in the bark



Figs 1-5. Male and female: 1-4) *Ananarsia lineatella*: 1, male genitalia, lateral aspect, 2) modified setae; 3) female genitalia, ventral aspect, 4) female VIII tergite, dorsal aspect; 5) *Grapholita dimorpha*, male genitalia, ventral aspect.

for hibernation. The larvae, appeared from the eggs on the fruits, bore the latter and develop, giving the adults of the third generation. The larvae appeared from the eggs oviposited by the moths of third generation excavate the hibarnaculum for overwintering.

Based on the collecting dates of the moths, it is reasonable to expect that in Primorskii krai *Ananarsia lineatella* developed into two generations.

HOST PLANTS. *Prunus* spp., *Persica* spp., *Armeniaca* spp., *Cerasus* spp., *Malus* spp., *Amygdalus* spp.

REMARKS. The species *Ananarsia lineatella* damage badly the gardening in many countries. It was included into list A2 N 172 in EPPO (European Plant Protection Organization) as quarantine pest (Smith et al., 1992). The most economic damage results during the summer when larvae of summer generations feed in the fruits and nut meats and renders it unfit for sale. Besides, the larvae feeding in the terminal shoots and tunneling them, cause the wilting of leaves and stop apical growth, that is more aloud in gardens with young trees, which are with a high degree of late season vegetative growth. Summarizing the data on the injure in stone Rosaceae in the orchards of different countries, the buds damage can reach up to 50-60 % in spring, and the yield fall is within 15-60 %. In Central Asia the peach twig borer occur together with apple seedworm (*Laspeyresia* spp.) and their total fruit damage in the peach, apricot and almond gardens reaches up 94.4%. In California *A. lineatella* together with *Amyelois transitella* (Walker) cause direct damage of more than $10 million to almond growers, invading the nuts and feeding on the meats (Agudelo-Silva et al., 1995). In Europe, Transcaucasus, Central Asia and Nearest East mainly the plum-trees, peach-trees, apricot-trees and almond-trees are damaged, and less the cherry-trees and apple-trees. In North America the *Ananarsia lineatella* is serious pest of peach, nectarine and apricot. The investigations in the Nearest East and North America show the effective methods to decrease the peach twig borer quantity is constant control of pest appearance by luring on pheromone traps and by using of insecticidal sprays. For pheromone traps the chimicals are used as following (E)-5-Decenyl acetate, (E)-5-Decen-1-ol, (E)-4-Decenyl acetate, (Z)-4-Decenyl acetate, (E,E)-3,5-Decadienyl acetate, (Z,E)-3,5-Decadienyl acetate (Rice & Jones, 1975; Roelofs et al., 1975; Formigoni et al., 1977; Hrdy et al., 1979; Millar & Rice, 1992). For *A. lineatella* control during the dormant season the organophosphate insecticides are recommended to apply routinely (Rice & Jones, 1988, Zalom et al., 1991, Zalom et al., 2002). Also for reducing of overwintering larval population of *A. lineatella* in hibernacula on almond trees in California orchards were applied infectives of *Steinernema carpocapsae* and a cold tolerant *Heterorhabditis* sp. in the dormant season (Agudelo-Silva et al., 1995). Acceptable results were obtained by using of combined chemicals and biologicals (Chepurnaya, 1994).

***Grapholita dimorpha* Komai, 1979**

Fig. 5

Grapholita dimorpha Komai, 1979, Appl. Ent. Zool. 14 (2): 133 (type locality: Kuzakai, Iwate Pref., Honshu, Japan).

DIAGNOSIS. The wingspan 11-14 mm; the forewing broad, the male hindwing concave in posterior part of termen and without androconial patch; costa of valva gently arched in male genitalia (Fig. 5); caudal margin of VII sternite convex and corpus bursae with large signa in female genitalia.

MATERIAL. Primorskii krai: 1 ♂, Oktyabrskii distr., 18 km W Pokrovka, middle course of Orlikha river, larva collected on *Armeniaca sibirica* with apricots 5.VII 2002, imago reared 21.III 2003 (leg. M. Ponomarenko); 1 ♀, the same locality and collecting conditions, imago reared 15.III 2003 (leg. M. Ponomarenko) (IBSS). Specimens lured on pheromone traps, obtained from FSVPS PA: 3 ♂, Khabarovsk, Scientific Research Institute of Agriculture, 8.VIII 2005; Primorskii krai: 1 ♂, Lesozavodskii distr., Markovo, 2.VIII 2005; 3 ♂, Khankaiskii distr., Turii Rog, 10.VII 2005; 2 ♂, Pogranichnyi distr., Grodekovo, 21.VIII 2005; 3 ♂, Ol'ginskii distr., Ol'ga, 23.VII 2005; 2 ♂, Partizanskii distr., Frolovka, 11.VII 2005; 4 ♂, Nadezhdinskii distr., 35 km N Vladivostok, 13.VII 2005; Vladivostok, Okeanskaya, 7.VIII 2005; Khasanskii distr.: 2 ♂, Slavyanka, 25.VII 2005; 2 ♂, Tsykanovo, 18.VII 2005; 2 ♂, Zarybino, 17.VII 2005.

DISTRIBUTION. Russia (South of Khabarovskii krai, Primorskii krai) - first record, Japan, Korea, China.

BIOLOGY. According to F. Komai (1979, 1999) the life cycle and behaviour in this species are similar to those in oriental fruit moth, *G. molesta* (Busck). But *G. dimorpha* differs by the place of cocoon spinning. The larva of *G. molesta* leaves the shoots or fruits before pupation, whereas *G. dimorpha* pupates under the surface of fruits. Just same behaviour was observed in larvae collected in Primorskii krai. The fruits of *Armeniaca sibirica* with feeding larvae were collected in June 2002. All larvae were pupated to the beginning of July, they leaved the fruits, attached firmly the apricots to the paper on the bottom of laboratory glassware and spinned the cocoons between fruit and paper surfaces.

HOST PLANTS. *Prunus salicina*, *Armeniaca sibirica*, *Chaenomeles speciosa*.

REMARKS. *G. dimorpha* was lured on the traps with pheromone of quarantine pest, *G. molesta*, and collected by staff of FSVPS PA. The identification of the material, collected this and last years, allows to find not only new species for Russian Far East, closely related to Oriental fruit moth, but, reasoning from strongly increasing of it's quantity in current year, new potential pest of gardening.

***Apocheima cinerarius* (Erschov, 1874)**
Figs 6-8

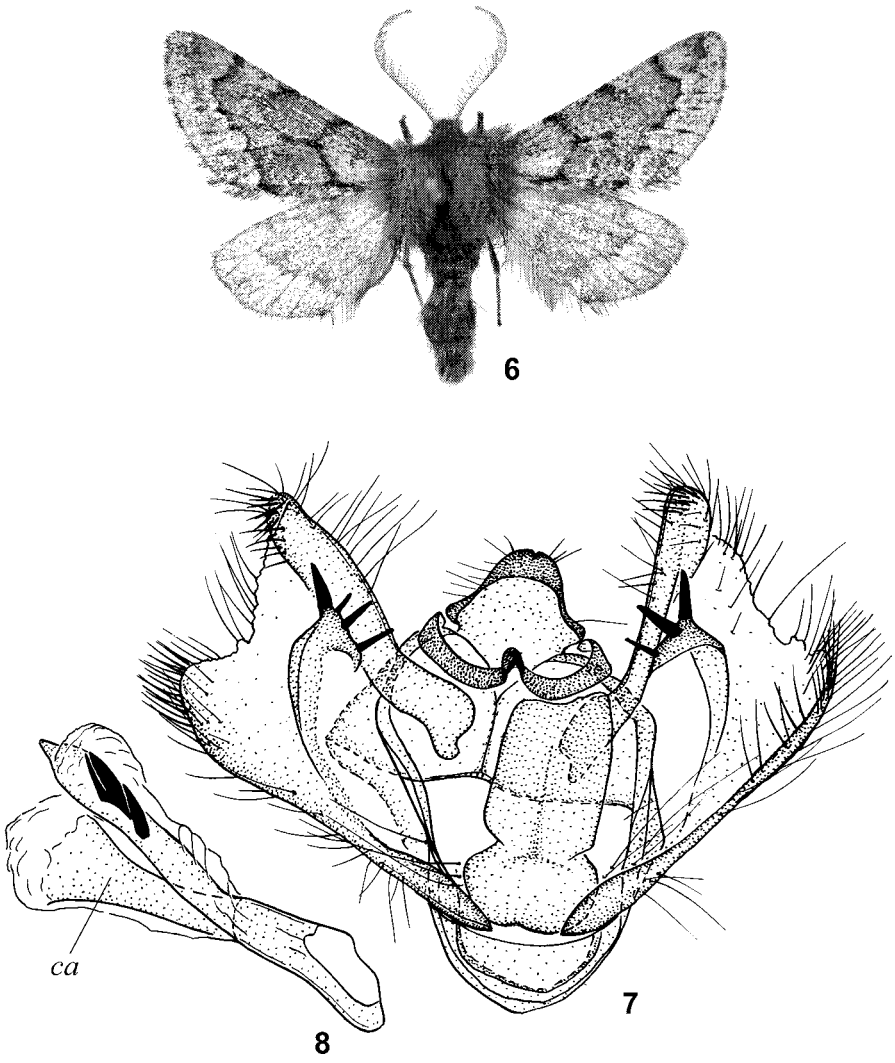
Biston cinerarius Erschov, 1874, in Fedtschenko, Puteshestvie v Turkestan 2(5): 64, pl. 4, fig. 65 (type locality: "Turkestan, Maracanda" [Uzbekistan, Samarkand]).

Apocheima cinerarius var. *isfacana* Wehrli, 1941 in Seitz, Gross-Schmet. Erde 4 (Suppl.): 418, pl. 3: g (type locality: "Fergana, Isfaca" [?Tajikistan, Isfara]).

Apocheima cinerarius pyri Yang, 1978, Moths of North China 2: 395, pl. "20" [21], figs 1, 2. (type locality: China, Beijing and Tianjin).

Yala pyricola Chu, 1979, Acta ent. Sinica 22 (1): 75, figs. 5, 6 (type locality: China, Peking [=Beijing]), **syn. n.**

DIAGNOSIS. Male. Wingspan 29-39 mm. Head, labial palpi and body are richly covered with long hairs, a head and eyes small, palpi rather long, antennae bipectinated



Figs 6-8. *Apocheima cinerarius*: 6) male; 7) male genitalia, ventral aspect, 8) aedeagus, dorsal aspect; *ca* – caulis.

up to top, pectins moderately long, thick, densely ciliated ventrally. Wings narrow, pointed to apex, forewings brownish-grey with distinct, black, slightly wavy ante- and postmedial transverse lines, and poorly marked medial and subterminal lines, basal field yellowish-grey, lighter than background of wings, hindwing grey with

moderately distinct postdiscal line. Veins thick, on the forewing R_1 and R_2 arise from discal cell, R_1 usually free, and R_2 free or anastomozed with stalk R_{3-4} near the branching of R_5, on hindwing Rs and M_1 on common stalk, anal veins 2. Hind tibia with 1 pair of spurs, abdominal tergites I-IV and VII-VIII with cross rows of strong hoe-like spines.

In the male genitallia uncus wide, rounded on apex, slightly doubled ventrally on the top, gnathos strong, with small medial expansion, valva wide, with well sclerotized costa and cucullus, ampulla strongly convex, flattened, lobe-like, rather long, almost straight on dorsal edge which directed dorsally and bearing 4-6 very strong thorns, sacculus extends beyond the distal margin of valva, juxta wide, distally articulated with narrow long well sclerotized caulis inosculated to aedeagus, aedeagus thin, weak, with a few thick thorn-like cornuti on vesica.

Female wingless, with bolster-like body 10 - 16 mm in length, brownish - grey, with rather long and thin legs, abdomen dorsally with cross rows of strong thorns, covered under scales.

MATERIAL. Russia: 17 ♂, "F. E. Russia, Primorje [Primorskii krai], W Hanka [Khanka] Lake, vic. Barabash-Levada, 20.IV-1.VII 1994 (leg. L. Danchenko)" (ZFMK); 6 ♂, Primorskii krai, Oktyabrskii distr., Poltavka, 5.IV 2002 (leg. unknown) (IBSS, FSVPS PA). China: 5 ♂, "Harbin, 19.IV 1952 (leg. unknown " (ZFMK); 1 ♀, "Harbin, 23.IV 1924 (leg. unknown)"; 1 ♀, "Harbin, 25.IV 1924 (leg. unknown)" (ZFMK).

Additional material. 1 ♂, Kyrgyzstan, 20 km S Frunze [Bishkek], IV 1978 (leg. S. Vasilenko) (SZMN). 1 ♂, Kazakhstan, 15 km SW Alma-Ata [Almaty], 19.III 1993 (leg. P. Logunov) (SZMN).

DISTRIBUTION. Russia (first record): Primorskii krai. North-East, North and North-West China (Heilongjiang, Inner Mongolia, Hebei, Shandong, Shanxi, Shaanxi, Henan, Ningxia, Gansu, Qinghai, Xinjiang, Sichuan), Kazakhstan, Kirghizstan, Uzbekistan, Turkmenistan.

BIOLOGY. Larva in China and Middle Asia is polyphagous of deciduous trees and shrubs, it eats buds, leaves, flowers and sets of pear, apple-tree, quince, apricot, peach, plums, mulberry, oleaster, walnut, elm, poplar, maple, acacias, etc.; the species is serious pest of fruit trees and poplars in China and mulberry in Middle Asia. The species has one generation per year. Moths emergence from late February to mid-April, when temperature in soil of 5-10 cm depth reaches up to 0°C. Females oviposit in bark cracks of trees. Larvae live during the late March - mid May, pupation has place in second half of May in ground of 3-20 cm depth near tree-trunks. Duration of pre-pupa stage is 4-7 days, pupa diapauses more than 9 months from the spring end of current year to the spring of next year (Djakonov 1955; Durdyrev, Myartzeva, 1990; Xiao, 1991). In Primorskii krai moths were caught in well insolated light oak forests in April, therefore on this territory the species obviously develops for a month later than it is described for North China and Middle Asia. An outbreak of the species is known in Heilongjiang Province near the Mishan city, which is paced only 35 km North of Turii Rog settlement (Russia: Primorskii krai) (Zhou et al., 1996).

SYSTEMATICS. *Apocheima cinerarius pyri* Yang, 1978 and *Yala pyricola* Chu, 1979 are undoubtedly synonymous to judge by the original descriptions and illustrations of both taxa. Specimens from the Primorskii krai well conform to both Chinese taxa in their appearance and male genitalia, but differs from nominative specimens from Central Asia in the male genitalia by shorter ampulla, which is approximately equal in length to distance between the outer edge of the ampulla basis and distal margin of valva, whereas in the Central Asian moths the length of ampulla is appreciably more than this distance. This difference allows to support the status of populations of *A. cinerarius* from North China and Russian Far East as separate subspecies *pyri* Yang. Also *A. cinerarius* morphologically is rather close to *Apocheima hispidaria* ([Denis and Schiffermüller], 1775), the type species of *Apocheima* Hübner, 1825. Therefore genus *Yala* Chu, 1979 (type species *Yala pyricola* Chu, 1979) needs to be treated as junior synonym of *Apocheima*, and new synonymy is proposed: *Apocheima* Hübner, 1825 = *Yala* Chu, 1979, **syn. n.**; *Apocheima cinerarius pyri* Yang, 1978 = *Yala pyricola* Chu, 1979, **syn. n.**

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